DEVELOPMENT OF AN INSECTICIDE BAITING SYSTEM APPLICABLE FOR THE CONTROL OF EXOTIC *VESPULA* (HYMENOPTERA: VESPIDAE) WASP SPECIES IN TASMANIAN FORESTRY OPERATION SITES.

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Abstract

Forestry activities in Tasmania can be severely affected by the presence of nests and large numbers of foraging workers of exotic *Vespula* wasps. A system of insecticidal baiting for nest destruction is described that provides temporary reduction of wasp numbers during forestry activities. There was a reduction in wasp numbers within a 50-metre radius of the baiting sites that was maintained for the remainder of the wasp season.

Introduction

Two exotic species of vespine wasps are well established in Tasmania. One species, *Vespula germanica* (Fabricius, 1793) is common throughout the state and has been of major pest status since 1959 (Bashford 2001). A second species, *Vespula vulgaris* (Linnaeus, 1758), was discovered in 2000 and has spread rapidly throughout the south of the state (Matthews *et al.* 2000).

During the late summer months vespine wasps are active in large numbers throughout Tasmania. The presence and activity of wasps have adversely affected forestry activities with frequent wasp stings reported. Movement of forest workers out of operational areas due to high populations of vespine wasps is costly, both in time lost and productivity (Shimizu *et al.* 1995). The most severe incidents involve nest disturbance caused by machinery, such as bulldozers used to remove dead standing trees, and manual activities such as pruning, thinning, and seed collection in the vicinity of nests. Multiple stings may result in a dangerous anaphylactic reaction (Perez-Pimiento *et al.* 2007). In Tasmania 27% of people stung by vespine wasps suffer anaphylaxis to some degree (Brown 2004). In addition with the advent of tourism ventures within State Forests, especially picnic and barbecue sites, high populations of vespine wasps severely diminish visitor enjoyment.

Large numbers of wasps within a forestry area generally indicate the presence of a number of nests. Use of fipronil, a slow acting insecticide, in a protein bait station system enables foraging workers to transport bait into the nest, eventually killing the colony (Sackmann *et al.* 2001). Wasps were observed to harvest the protein bait over a one to two day period and accumulate enough insecticide within the nest to greatly reduce the wasp field population and cause nest mortality within five days of baiting. Grant *et al.* (1968) first trialled insecticide-laced protein baits, cooked ground horsemeat containing 1% chlordane, in suburban areas of California, and found them highly effective. Chang (1988) tested a number of insecticide/bait combinations for

area-wide control of *Vespula pensylvanica* Saussure, 1857 within sugar cane plantations in Hawaii. Since then there have been a number of trials using fipronil formulations to control *Vespula* species in New Zealand (Spurr 1996), Argentina (Sackmann *et al.* 2001), Tasmania (Warren & Statham 2002) and South Australia (Glenys Wood, pers. comm.).

This study investigated the efficacy of remote feeding stations baited with fipronil in ground meat for reduction of *V. germanica* and *V. vulgaris* populations by colony destruction in forestry situations. Promising results have resulted in incorporation into operational management.

Methods

Evaluation of protein bases (beef mince, wallaby mince, sardines, sardine based cat food, and chicken nuggets) was made prior to this trial. Other workers had previously recorded the attractiveness of these protein sources in field trials (Sackmann 2001, Spurr 1996, Beggs 1998). In this study observations indicated that fresh ground wallaby mince was visited more frequently than other protein sources and, with the addition of water crystals, did not desiccate as quickly as most other protein sources.

Bait stations were constructed of 30 x 12cm lengths of packing case wood as a base and roof held 15cm apart by walls of Gutterguard ® plastic mesh. The plastic mesh was stapled to the wood sections with one side unstapled to allow bait placement inside the cage. The mesh size of $1cm^2$ provided easy access to wasps. Traps were suspended 1.5 metres above the ground from a convenient branch using piano wire.

The bait selected consisted of 500g minced wallaby meat marinated overnight in a 500ml 0.1% (w/v) solution of the phenyl pyrazole, Fipronil (Termidor ® 100SC) provided by Aventis CropScience Pty Ltd. Marinated mince bait was drained and mixed with water absorbent crystals (Nylex ® Water Crystals, active constituent 80% Acrylamide co-polymer) at a rate of 3g crystals per 500g mince. Water crystals reduced the rate of desiccation of the protein bait in the traps, doubling the length of time they were attractive to wasps in the field. The mince mixture was divided into 20g blocks and individually packaged in zip-lock bags. These blocks were stored in the fridge for use within a few days or in the freezer for longer-term storage.

Following the methods of Beggs *et al.* (1998), a bait station was located in the middle of each of two recently logged coupes (WR001B and WR008H) in the Warra LTER site (146° 40'E, 43° 04'S) in southern Tasmania. A third recently logged coupe (WR008B) served as a control site with non-baited Malaise traps set up as in the other coupes. A Malaise trap was placed a few metres away from each bait station and additional Malaise traps set in a transect line at distances of 50 and 100 metres from the bait station. A total of five Malaise traps were used in each transect. At the control coupe Malaise

traps were set up at the same distances apart but without a bait station. Malaise traps were run from October to June in 1999/2000 and 2000/2001. The traps were emptied every month and on a weekly basis for three weeks following each baiting period and the numbers of vespine wasps counted. In late summer when natural protein sources were depleted and wasp populations high, baits would be quickly found and eaten.

Bait stations were run for three days on each of three occasions (4-6th December 1999 when queens were active following overwintering, 24-26th March 2000 and 17-19th March 2001 when workers were very active). After three days the bait blocks were inspected and the traps removed. Wasps located the bait stations within several hours eliminating the need to pre-bait the area. D'Adamo *et al.* (2003) demonstrated that once *V. germanica* located a bait source the visual stimulus of wasp activity guided other workers to that site resulting in rapid removal of the bait.

Results

The initial baiting in December 1999 appeared to have little influence on the numbers of queens captured in Malaise traps as there were similar numbers of queens captured at baited and control sites (Table 1). Queens were observed visiting the baits but very little bait was removed as the blocks appeared relatively intact on the third day. This may indicate that foraging queens are not focussed on protein collection but perhaps spend more time collecting wood pulp for nest construction (Ravaret-Richter 2000).

Table 1. Effect of insecticide baiting on *Vespula germanica* queens following overwintering.

Coupe	Treatment	Number of queens in Malaise trap			
		Week prior to baiting	Week following baiting	Three weeks after baiting	Nine weeks after baiting
WR001B	Baited	2	5	15	9
WR008H	Baited	0	3	11	9
WR008B	Not Baited	3	3	7	9

At the two treatment sites, baiting in March of both years resulted in a marked decrease in the number of wasps collected in Malaise traps within 50 metres of the bait station. Figure 1 illustrates the mean number of wasps collected combined for both baited sites pre- and post-baiting versus the control site. In both cases most of the bait was removed from the bait station during the first day and in all cases no bait remained on day three. The populations of wasps at these sites did not recover appreciably in the three weeks following baiting in either year.

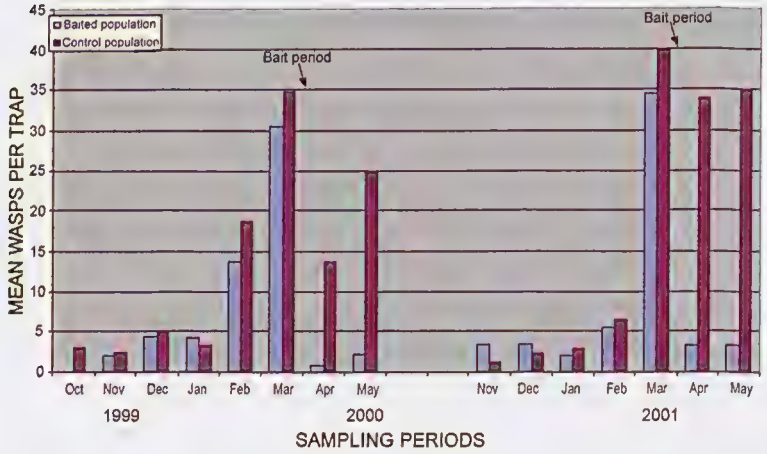

Fig. 1. Impact of baiting on *Vespula* populations.

At the baiting sites (WR001B and WR008H) wasp numbers in Malaise traps in the immediate vicinity of the bait traps declined on average by 98% within one week of baiting. After three weeks the reduction in the Malaise trap catches was still 96-98% of the pre-baiting. In contrast at the control site (WR008B) the wasp numbers in Malaise traps at the centre of the coupe had increased by an average of 23.5% after three weeks across both years.

At 50m from the bait station wasp captures in the baited coupes declined by 90-91% one week after baiting and by 77-90% after three weeks, compared with the control coupe where wasp captures after three weeks were similar to the initial levels.

At 100m from the bait stations wasp captures one week after baiting declined by 56% in one coupe but increased by 5% in the other. The control had increased by 23%. After three weeks one coupe had a reduction of 34% but the other coupe had an increase of 55%. The control had increased in population by 14%. Due to insufficient replication it is difficult to determine any impact at the 100-metre range.

There was a marked reduction in wasp numbers at the baiting site and the 50-metre distance from both baiting sites which persisted for at least three weeks.

Discussion

Since arriving in Tasmania in 1959, the European wasp, *V. germanica*, has spread throughout the state (Bashford 2001). The wasp colonises all open or partly shaded sites where nest construction is possible. The discovery of a second vespid species, the common wasp, *V. vulgaris,* in Tasmania

Table 2: Impact of insecticide baiting on numbers of *Vespula germanica* workers.

		Number of wasps captured					
Coupe		WR001B		WR008H		WR008B	
Treatment		Baited		Baited		Control-not baited	
Year		2000	2001	2000	2001	2000	2001
Bait station Malaise trap	Pre bait	41	35	31	24	31	50
	One week post baiting	1	0	0	1	15	48
	Three weeks post baiting	0	1	1	1	35	7
50 metres Malaise trap	Pre bait	31	46	19	33	22	37
	One week post baiting	1	7	1	4	19	29
	Three weeks post baiting	3	4	5	7	25	36
100 metres Malaise trap	Pre bait	31	28	42	48	27	56
	One week post baiting	23	39	3	37	32	70
	Three weeks post baiting	31	31	10	49	33	62

(Matthews *et al.* 2000) is of increased concern to forestry workers since it also inhabits closed canopy areas of the forest, thus potentially increasing the distribution of exotic vespine wasps in the state. Currently *V. vulgaris* is restricted to the south and central north of the state where it competes for nest sites with *V. germanica*, and therefore has thus not necessarily resulted in overall increases in *Vespula* populations.

However *V. vulgaris* is able to form nests and forage in closed canopy forests adjacent to open sites. This has resulted in an increase in the land area occupied by introduced vespine species and in wetter forest types utilised by the forest industries.

Both visual and olfactory cues are important to wasps seeking prey. Gaul (1952) reported upwind flights to carrion as an important location technique.

December baiting was investigated following the work of Grant (1963) who suggested that baits applied early in the wasp season would serve to reduce populations of queens that had overwintered and thereby reduce nest establishment. This trial suggests that this is probably not the case, as very few queens were attracted to the baits in December.

Spurr (1997) using a sardine based cat food containing sulfluramid, found that wasp numbers were reduced by up to 90% within 10 days, while Sackmann (2001) reported 87% reduction in wasp numbers, using a bait consisting of 0.1% fibronil-laced minced beef, results comparable to those reported here. In pre-testing of protein bases the current study found that in warm weather both sardines and sardine based cat food developed hard crusts within hours of exposure, rendering them unattractive to wasps, while chicken nuggets were rarely visited. Initially, there was little difference between fresh minced beef and minced kangaroo meat in their attractiveness to wasps. However the kangaroo mince maintained its 'attractiveness' for several days longer than minced beef when both were mixed with water crystals. In areas of low nest density the addition of water crystals ensured the baits stayed attractive over a longer period enabling foraging workers to find and remove the baits.

The data obtained from the current study showed that bait stations reduced high population densities by at least 77% over a radius of 50 metres. However the results need to be verified by a more substantial trial incorporating sufficient replication to provide a robust analysis of the data.

Forestry operations such as harvesting and road building provide numerous opportunities for vespine wasps to establish nests. Subsequent operational activities at these sites result in disturbance of foraging wasps and nest sites. Forestry workers have been stung and high population numbers have resulted in cessation of work activities. For forestry operations involving manual labour such as pruning or thinning, it is recommended that bait stations be established at 100m spacing along transects within coupes at least one week prior to work commencement. Prior to thinning and pruning operations surveys should be conducted to determine tree selection and areas and observations of wasp activity made during these surveys to enable a decision on the need for wasp treatment. Following baiting there would be at least a three-week period when operations could be conducted without being affected by foraging wasps.

The baiting system detailed in this paper has been adopted by forestry planning managers in Tasmania and is used in both hardwood and softwood coupes prior to thinning and pruning operations where high wasp populations have been reported.

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